Wasikul Islam

Curriculum Vitae

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Professional Summary

Senior machine-learning expert and a particle physicist with a Physics PhD and 10+ years of experience building large-scale data analysis, HPC-enabled scientific simulation and AI systems in highly complex experimental physics environments. Proven track record developing first-of-its-kind anomaly detection, representation learning, and computer-vision solutions deployed in production scientific workflows at CERN and multiple DOE laboratories. Experienced in deep learning, high-performance data pipelines, and large-scale scientific computing efforts. Motivated to apply advanced ML, physics and software engineering expertise to impactful industry and product-focused roles.

Core Skills

Machine Learning & AI: physics-informed neural networks, surrogate modeling, graph neural networks, Anomaly detection, self-supervised and contrastive learning, Transformer architectures, representation learning, computer vision, image denoising, sequence and set models, model evaluation, benchmarking, experimental design.
ML Frameworks/Tools: PyTorch, TensorFlow, CUDA-aware workflows, scikit-learn, NumPy, SciPy, Matplotlib.
Data Engineering & Analytics: SQL-style data transformations, analytics-ready datasets, statistical data analysis, data modeling, feature engineering, performance optimization, reproducible data pipelines.
Software Engineering: Python, C++, Linux/UNIX, Git, CI/CD workflows, modular system design, production-quality code, debugging and optimization in large, complex codebases.
Data Systems & Infrastructure: Large-scale, distributed computing, high-performance computing, optimization and performance analysis, workflow automation, scalable data pipelines, experiment tracking, data quality validation.
Domain Expertise: Physics-based simulation, sim-to-real validation, scientific visualization, signal detection in noisy environments, sensor and time-series data analysis, uncertainty quantification, physics-informed and safety-critical ML, real-time inference.

Professional Experience

2024 – Present **Scientist I** *University of Wisconsin–Madison, USA.*
- Lead development of machine-learning–driven algorithms and tools for next-generation physics discovery at the High-Luminosity LHC.
- Designed and deployed scalable ML pipelines from simulation for vertex and event selection under extreme pileup conditions, emphasizing robustness, reproducibility, and safety-critical evaluation.
- Co-developed **AD-Filter**, a production-grade web platform enabling anomaly-driven event filtering and model reinterpretation.
- Delivered reusable software and ML frameworks adopted by large, international research teams for complex physics searches.

2023 – Present **Research Affiliate** *SLAC National Accelerator Laboratory, Stanford University, USA.*
- Developed novel AI/ML algorithms for advanced particle tracking, vertexing, and sensor-level data interpretation, leveraging HPC and GPU-accelerated workflows.
- Designed new strategies for primary vertex selection and jet–pileup mitigation, including methods leveraging timing information for 4D tracking.
- Explored graph-based and learning-based models to improve reconstruction performance for HL-LHC and future collider environments.
- Collaborated closely with experimental and software teams to validate and integrate new algorithms into realistic workflows.

2021 – 2024 **Research Associate** *University of Wisconsin–Madison, USA / CERN, Switzerland.*
- Pioneered the first event-based, model-agnostic anomaly detection framework for new-physics searches.
- Combined unsupervised and supervised ML techniques to identify rare and unexpected patterns in high-dimensional collision data.
- Served as editor and lead analyzer for a *Physical Review Letters* publication (2024), with results highlighted by CERN and international media.
- Established ML-driven methodologies for complex physics studies, forming the foundation for later production tools and analyses.

High-Performance Computing & Simulation

Extensive experience with GPU-accelerated ML and large-scale simulations on national supercomputing facilities, including NERSC (Perlmutter), Argonne Leadership Computing Facility, and CERN HPC clusters; applied CUDA-enabled workflows for ML training, inference, and simulation analysis.

Recent Research Projects, Publications & Impact

Author of 700+ peer-reviewed publications with large international collaboration at CERN, with research spanning anomaly detection, AI/ML for scientific discovery, computer vision, and large-scale data analysis. Work includes first-of-its-kind ML-driven discovery frameworks, adopted analysis tools, and high-impact published results.
Profiles: Google Scholar: link ORCID: 0000-0002-5624-5934 INSPIRE-HEP: W.Islam.1.

Selected Recent Publications (with significant personal contributions):

- **Event-Based Anomaly Detection for New Physics Searches**, *Physical Review Letters* **132**, 081801 (2024). Introduced the first event-level, model-agnostic anomaly detection framework at the LHC; enabled discovery-driven searches without supervised labels.
- **ADFilter: A Web-Based Platform for Unsupervised Anomaly Detection**, *Information* **16(4)**, 258 (2025). Designed and deployed a production web tool enabling interactive ML-driven anomaly filtering.
- **Double-Higgs boson search sensitivity improvement with AI/ML**, arXiv:2504.12418 (2025). Proposed two novel machine-learning architectures for discovering di-Higgs boson.
- **Compact Representation of Events for Physics-Informed Machine Learning**, arXiv:2602.17563 (2026). Proposed innovative compression technique for particle physics collision data.
- **New Physics Searches in Complex Final States at the LHC**, JHEP **12** (2023) 073; JHEP **07** (2023) 202. Applied innovative data analysis techniques to improve sensitivity in high-dimensional, noisy environments.
- **Model-Independent Discovery Strategies of new physics**, *Universe* **7(9)**, 333 (2021). Early exploration of novel discovery methods that inspired later large-scale analysis at ATLAS experiment at CERN.
- **Physics-Inspired Image Denoising with Weighted Inductive Biases (WIPUNet)**, arXiv:2509.05662 (2025). Proposed a novel deep-learning architecture incorporating domain-informed inductive biases for image denoising.
- **AI-Based Tracking Algorithms:** Designed multiple AI/machine learning-based tracking methods for next-generation detectors operating under extreme pileup and noise conditions (Currently in review).

Education

Ph.D. in Experimental Particle Physics, Oklahoma State University, USA 2021
B.Sc. & M.Sc. in Physics, Aligarh Muslim University, India 2015

Honors & Recognition

- Co-recipient, **2025 Breakthrough Prize in Fundamental Physics** (ATLAS Collaboration, CERN).
- Elected Full Member, Sigma Xi – The Scientific Research Honor Society (2025).
- Wisconsin Initiative for Scientific Literacy Award (2024) News link.
- University of Wisconsin Postdoctoral Excellence Award (2023) News link.
- APS Career Mentoring Fellow, American Physical Society (2022).
- ANL–ATLAS Graduate Fellowship, Argonne National Laboratory (2018) News link.

Leadership & Service

- Member of the ATLAS Experimental Collaboration at CERN (2016–Present), contributing to one of the world's largest and most complex scientific and software-driven research programs.
- Led and coordinated analysis efforts within large, international teams, serving as editor, analysis contact, and technical reviewer for high-impact, peer-reviewed publications.
- Held senior coordination roles in the ATLAS Collaboration, including leadership responsibilities within the flavor-tagging group and editorial boards for machine-learning–based anomaly detection studies.
- Gave talks at 20+ major physics conferences, presenting research.
- Mentored undergraduate and graduate researchers in AI/ML, data analysis, algorithm development for physics.
- Contributed to the scientific community as a reviewer for international journals and at conferences.
- Designed and delivered technical training, outreach, and educational initiatives, including accessible programming instruction for visually impaired students.
- Demonstrated leadership in nonprofit governance and science communication initiatives.